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A comparison of groundwater storage using GRACE data, groundwater levels, and a hydrological model in California's Central Valley

The Gravity Recovery and Climate Experiment (GRACE) measures changes in total water storage (TWS) remotely, and may provide additional insight to the use of well-based data in California's agriculturally productive Central Valley region. Under current California law, well owners are not required to report groundwater extraction rates, making estimation of total groundwater extraction difficult. As a result, other groundwater change detection techniques may prove useful. From October 2002 to September 2009, GRACE was used to map changes in TWS for the three hydrological regions (the Sacramento River Basin, the San Joaquin River Basin, and the Tulare Lake Basin) encompassing the Central Valley aquifer. Net groundwater storage changes were calculated from the changes in TWS for each of the three hydrological regions and by incorporating estimates for additional components of the hydrological budget including precipitation, evapotranspiration, soil moisture, snow pack, and surface water storage. The calculated changes in groundwater storage were then compared to simulated values from the California Department of Water Resource's Central Valley Groundwater-Surface Water Simulation Model (C2VSIM) and their Water Data Library (WDL) Geographic Information System (GIS) change in storage tool. The results from the three methods were compared. Downscaling GRACE data into the 21 smaller Central Valley sub-regions included in C2VSIM was also evaluated. This work has the potential to improve California's groundwater resource management and use of existing hydrological models for the Central Valley.